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Features of excessive alcohol drinking in older adults distinctively captured by behavioral and biological screening instruments: An epidemiological study

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Abstract

The entire ⩾65-year-old population living in a small Italian town, where alcohol use is almost ubiquitous, was assessed with a frequency–quantity questionnaire for alcohol intake and with two screening instruments for alcohol problems, the CAGE questionnaire and the MCV-γGT test. Aim of the study was to assess whether these instruments identify different subsets of subjects with alcohol problems. Of the 649 participants, 19.1% were at-risk drinkers (average intake >40 g/day in men and >20 g/day in women). Both the screening instruments were positive in only a minority of participants. Of the 377 drinkers, 53 gave ⩾1 affirmative response to the CAGE questionnaire, whereas 24 had a positive MCV-γGT test. The concordance between positive CAGE questionnaire and MCV-γGT test was limited to seven subjects (kappa = 0.10), and these tests identified subjects who differed for several health and psychosocial characteristics. Participants aged ⩾75 years drank less, but had similar prevalence of CAGE and MCV-γGT positive markers as compared to younger participants. In conclusion, excessive drinking is common in the elderly. Screening tests based on behavioral and biological markers identify two different sets of subjects with possible alcohol problems. This might indicate the opportunity to use these instruments in conjunction.

Keywords: Alcohol; Alcohol problems; Elderly; Screening; Epidemiology

1. Introduction

In recent years, a growing amount of interest has been devoted to alcohol problems in older persons as a relevant public health issue. The prevalence of formal, major alcohol disorders, such as abuse or dependence, is greater in young- and middle-aged than in older individuals [1,2], yet the risk of dependence for a given alcohol intake increases with advancing age [3]. Furthermore, alcohol problems include (beyond abuse and dependence) a broad spectrum of physical, psychological, and social disorders, which in older persons are often erroneously attributed to other age-related conditions. Therefore, excessive alcohol consumption frequently remains an unrecognized cause of mortality and morbidity of older persons [4]. It can be argued that alcohol problems are more likely to be overlooked in populations where alcohol drinking is ubiquitous and socially accepted, as in certain regions of Italy [5,6].

Primary care physicians are well positioned to identify subclinical alcohol disorders in the context of patient contact for other problems, and they are prompted to routinely assess patients about alcohol use and misuse [7]. Nevertheless, many patients with at-risk or harmful drinking habits remain undiagnosed by their physicians [8]. A recent survey reported that only 47% of primary care physicians regularly ask patients about the maximum alcohol intake on a single occasion, and only 13% of them use formal screening tools for alcohol problems [9]. Screening for alcohol problems is usually based on the detection of specific behavioral characteristics with structured interviews, among which the CAGE ques-

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tionnaire has been extensively used in older adults [10,11]. A different approach is offered by laboratory tests for the metabolic effects of alcohol, among which measurement of mean corpuscular volume (MCV) and gamma-glutamyl-transpeptidase (γGT) is low-cost and usually performed in clinical practice. Both MCV and γGT increase in patients with excessive alcohol intake and their simultaneous elevation has been used as a screening tool in epidemiological settings [12]. To our knowledge, the performance of these two screening approaches has not been compared in older persons living in the community. Due to the multifaceted profile of alcohol problems, screening tools for this condition should be compared not only for their performance versus a common reference standard (criterion validity) [13,14], but also in terms of specific domains covered by each instrument (construct validity). If instruments that explore different aspects of alcohol problems have a poor concordance, this might suggest the need to use them in conjunction.

This study was carried out to verify the hypothesis that behavioral and biological markers identify distinct subsets of older individuals with alcohol problems. Data used in this analysis were collected in a cross-sectional, epidemiological survey, primarily focused on heart failure, which included all the community-dwelling individuals 65 years of age and over resident in Dicomano, a small rural town near Florence, Italy ("Insufficienza Cardiaca negli Anziani Residenti a Dicomano," ICARe Dicomano Study) [15]. In this geographic area, production of red wine is extensive and per capita level of alcohol intake is one of the highest in the nation [16].

2. Methods

2.1. Study protocol

The ICARe Dicomano Study, whose general design has been detailed elsewhere [15], enrolled the community-dwelling, elderly (⩾65 years) population recorded in the City Registry Office on April 1995. The only exclusion criterion was living in a nursing home. According to the original study protocol [15], multidimensional, geriatric assessment [17] data were collected with home interview, biological testing and clinical examination, after informed consent. Proxy interviews were obtained for cognitively impaired participants who scored less than 5 out of 10 in the first two domains of the Mini Mental State Examination (MMSE) [18] or with severe sensory impairment. All the interviews and clinical examinations were carried out by geriatricians or geriatric fellows. Information was also gathered from participants' general practitioners.

2.2. Data collection

A frequency–quantity questionnaire, with a color atlas of containers of known volume (V, ml), was used to record alcoholic beverage intake. Participants were asked to report types and average amount of alcoholic beverages consumed weekly. Alcohol consumption (A, g/day) was calculated from the formula: $A = \Sigma (V \times G \times 0.80)$, where G is alcohol gradation (%) and 0.80 is the specific gravity. Assumptions on G were: beer 5%, table wine 12.5%, dessert wine 17%, bitters 30%, liquors 40%.

In agreement with previous studies sponsored by the World Health Organization (WHO) [19], an alcohol intake in excess of 40 g/day for men and 20 g/day for women was considered at-risk drinking. A higher WHO threshold (60/40 g/day) was also considered [19]. Behavioral and biological evidence of possible alcohol problems was investigated when the participant reported any current drinking. The CAGE questionnaire [10] was administered only in case of non-proxy interview and, to improve its sensitivity [20], not immediately after the frequency–quantity questionnaire. Unless otherwise specified, a cut-off of one positive answer was used [21]. The elevation above the upper normal value in our laboratory of both MCV (>91 fl) and γGT (>40 U/L) was considered as a biological marker of possible alcohol problems (positive MCV-γGT test) [12]. The status of these markers of possible problem drinking was assessed independently of the actual alcohol intake.

Marital status, household composition, years of formal education and previous occupation were recorded. Ownership of participants' house and subjective judgment of their income were taken as indicators of economic status. The social network was explored with several questionnaire items. The participants were asked to list the persons they were in touch with and to score from 1 (minimal level) to 4 (maximal level) for each of them, the frequency of contacts, the strength of each bond, and the help they felt available in case of need.

Self-rated health (on a 5-level scale, from excellent to poor), the number of physician's visits in the preceding year and the number of current medications were considered as indicators of health status. Disability (need for help in ⩾1 basic activities of daily living) was evaluated with a modified WHO scale [22]. Comorbidity was assessed from standardized diagnostic algorithms [15] based on both symptoms and specific diagnostic tests, and the total number of chronic conditions was calculated. Cognitive impairment, depressive or anxiety symptoms were screened with the MMSE [18], the Geriatric Depression Scale [23] and a brief version of the Hopkins' Symptoms Check List (HSCL) [24], respectively.

2.3. Analytic procedure

Statistical analysis was performed with the SPSS for Windows 8.0 package. Mean values are expressed as mean ± SEM. The Student's *t*-test and the chi square test were used to compare mean values and relative frequencies, respectively. Agreement between the CAGE questionnaire and the MCV-γGT test was analyzed with kappa statistics.

Bivariate associations of candidate predictors with excessive alcohol intake, positive CAGE questionnaire or MCV-γGT test were first separately identified. To this purpose,

parametric variables were dichotomized using standard cut-off points whenever possible or, otherwise, contrasting one extreme of the population distribution (10th or 90th percentile) to the remaining population. Selection between the 10th and the 90th percentile was supported by the clinical significance of each variable as a potential risk factor for alcohol problems. Thus the MMSE score, which decreases with cognitive impairment, and the Hopkins' Symptoms Check List score, which increases with anxiety symptoms, were dichotomized at 21 (10th percentile) and at 1.5 (90th percentile), respectively.

Logistic regression was used to identify the independent predictors of at-risk drinking and of possible alcohol problems. To this purpose, three separate logistic regression models were considered, including all the variables that, at bivariate comparisons, were associated ($P < 0.1$) with either at-risk drinking, positive CAGE questionnaire, or positive MCV-γGT test. Redundant variables were deleted backward to obtain final parsimonious models. A two-tailed $P < 0.05$ was considered significant.

3. Results

Data on drinking behavior were available in 649 (262 men, 387 women) of 864 subjects originally eligible for the ICARe Dicomano study [15]. Of the 215 subjects not included, 4 died before study onset, 163 refused to participate, 48 had proxy or incomplete interviews. Non-participants tended to be older (age: 74.9 ± 0.5 years) than participants (73.8 ± 0.3 years; $P = 0.053$) and they were predominantly males (non-participating men: 51.2% vs. non-participating women: 48.8%; $P = 0.006$). According to the general practitioners' reports, alcohol problems were twice as frequent in non-participants than in participants (3.0% vs. 1.6%; $P = 0.203$).

In the study population, 272 subjects (41.9%) did not consume alcohol, 253 (39.0%) drank less and 124 (19.1%) more than the 40/20 g/day limit (at-risk drinkers). A heavier drinking habit (>60/40 g/day) was recorded in 58 participants (8.9%). The demographic and health characteristics of the participants are reported in Table 1, according to the level of alcohol consumption. Alcohol drinking was more frequent in younger participants and in men (Table 1 and Fig. 1).

When the 377 drinkers were screened for possible alcohol problems, 53 of them gave one or more, and only 17 two or more, affirmative responses to the CAGE questionnaire, whereas 24 had a positive MCV-γGT test. Three men with positive MCV-γGT test were taking anticonvulsant drugs: alcohol consumption was 2 and 25 g/day in two of them (possible false positives) and 56 g/day in the third one. However, comparisons involving the MCV-γGT test were unaffected when these three subjects were excluded from the analyses.

Markers of possible alcohol problems were positive in a minority of at-risk drinkers (>40/20 g/day) (Fig. 2). Clearly, these prevalence figures were higher when only the participants who drank above the 60/40 g/day limit were considered (Fig. 2). On the other hand, 90–98% of participants who had at least one marker suggesting alcohol problems drank above the 40/20 g/day limit. The concordance between positive CAGE questionnaire and MCV-γGT test was limited to seven subjects: isolated positive CAGE questionnaire or MCV-γGT test were observed in 46 and 17 cases, respectively (kappa = 0.10).

Table 2 reports the bivariate associations of at-risk drinking and, separately, of a positive CAGE questionnaire or MCV-γGT test. Whereas the overall distribution of alcohol

Table 1
Demographic and health characteristic of the study sample, by alcohol intake level

	Non-drinkers ($n = 272$) n (%)	⩽40/20 g/day ($n = 253$) n (%)	>40/20 g/day ($n = 124$) n (%)	Total ($n = 649$) n (%)
Demographic and social variables				
Age 75+ years	116 (42.6)	94 (37.2)	32 (25.8)	242 (37.3)
Female sex	217 (79.8)	122 (48.2)	48 (38.7)	387 (59.6)
Education ⩽6 years	254 (93.4)	220 (87.0)	105 (84.7)	579 (89.2)
General health status				
Current or ex-smoker	72 (26.5)	125 (49.4)	77 (62.1)	274 (42.2)
>5 drugs	26 (9.6)	15 (5.9)	3 (2.4)	44 (6.8)
>3 chronic diseases	7 (2.8)	14 (5.7)	5 (4.2)	26 (4.2)
Disability in ⩾1 BADL	25 (9.2)	15 (5.9)	3 (2.4)	43 (6.6)
Cognition and mood				
MMSE ⩽21	32 (11.8)	25 (9.9)	12 (9.7)	69 (10.6)
GDS ⩾14	92 (34.5)	59 (23.5)	22 (17.7)	173 (26.9)
HSCL >1.5	20 (7.8)	24 (9.6)	4 (3.3)	48 (7.6)

Abbreviations: BADL: basic activities of daily living. MMSE: Mini Mental State Examination. GDS: Geriatric Depression Scale. HSCL: Hopkins' Symptoms Check List.

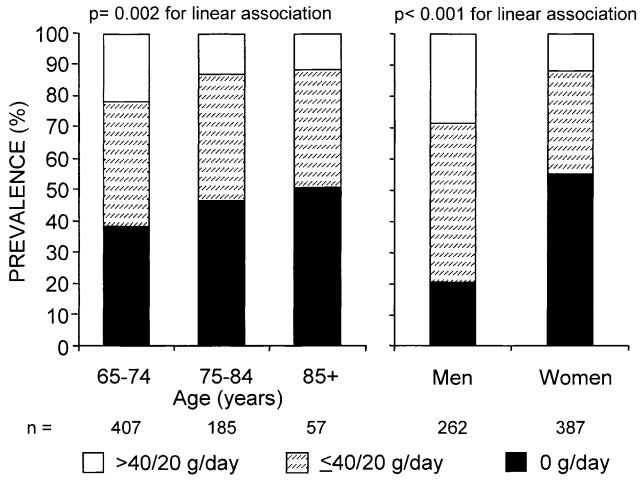

Fig. 1. Average alcohol intake, according to age and gender. An average daily alcohol intake above 40 g/day in men and 20 g/day in women was considered at-risk drinking.

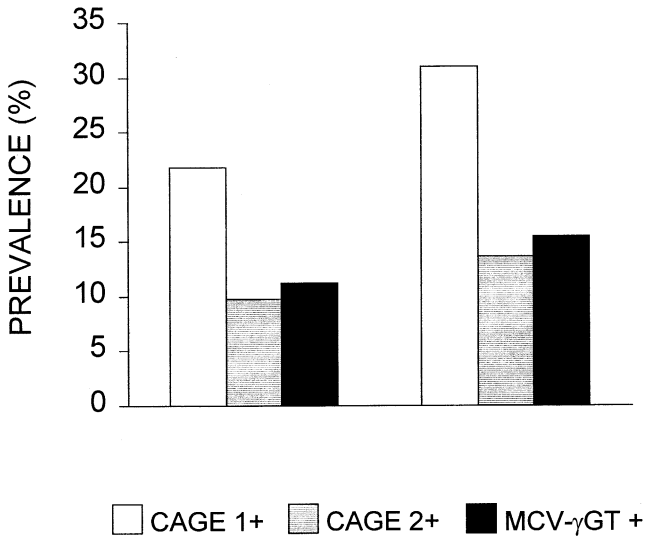

Fig. 2. Proportion of at-risk drinkers (40 g/day in men and 20 g/day in women, and 60 g/day in men and 40 g/day in women cut-offs) with positive markers of possible alcohol problems. CAGE 1+, at least one positive answer to the CAGE questionnaire; CAGE 2+, at least two positive answers to the CAGE questionnaire; MCV-γGT +, mean corpuscular volume >91 fl and gamma-glutamyl-transpeptidase >40 UI/L.

intake differed by age and gender (Fig. 1), the risk of a positive marker for possible problem drinking was comparable above and below the age of 75 years. At-risk drinking was independent of gender, whereas a positive CAGE questionnaire or MCV-γGT test were both significantly less common in women (Table 2). Drinking was associated with specific aspects of participants' social relationships. Indeed, at-risk drinkers reported weaker personal bonds, whereas CAGE-positive individuals scored poorly on the item which indicated the help felt available from their contacts in case of need, though they had a similar frequency of contacts and were more frequently married. At-risk drinkers reported less anxiety symptoms and a better self-rated health, whereas markers suggestive of alcohol problems were associated with a poorer health status. Indeed, CAGE-positive subjects were taking more drugs and MCV-γGT positive subjects had a higher prevalence of comorbidity and disability. Smokers were largely prevalent in at-risk drinkers, as compared to moderate drinkers, as well as in participants who screened positive to either the CAGE questionnaire or the MCV-γGT test, in comparison to those who screened negative (Table 2).

In a multiple logistic analysis model, at-risk drinking was associated with smoking habit, better self-rated health, weaker social bonds and, although marginally, with an age <75 years and a lower anxiety score (Table 3). Besides average alcohol intake, other variables differentially added to the prediction of either a positive CAGE questionnaire or MCV-γGT test. In fact, CAGE-positive individuals were more frequently older than 75 years, smokers, and married. They also more frequently complained of scarce help from their social network. Conversely, a positive MCV-γGT test was more common in men and in disabled subjects.

Table 2
Factors associated with at-risk alcohol intake (≥40/20 g/day) and with behavioral (CAGE 1+) and biological (MCV-γGT+) markers of possible alcohol problems

Factor	N	%[a]	≥40/20 vs. <40/20 g/day OR (95% CI)	CAGE 1+ vs. CAGE 0 OR (95% CI)	MCV-γGT+ vs. MCV-γGT− OR (95% CI)
Demographic and social variables					
Age 75+ years	377	33.4	0.6 (0.4–0.9)	1.4 (0.8–2.5)	1.5 (0.6–3.4)
Female gender	377	45.1	0.7 (0.4–1.1)	0.2 (0.1–0.5)	0.2 (0.1–0.7)
Education ≤6 years	377	86.2	0.8 (0.5–1.5)	0.6 (0.3–1.4)	0.8 (0.3–2.4)
Inadequate income	370	50.0	1.0 (0.6–1.5)	0.6 (0.3–1.1)	1.4 (0.6–3.3)
Not house owner	376	43.4	1.0 (0.7–1.6)	0.8 (0.5–1.5)	1.6 (0.7–3.8)
Being unmarried	376	32.7	0.6 (0.4–1.0)	0.2 (0.1–0.7)	0.7 (0.3–1.7)
Fewer social contacts[b]	377	9.0	0.7 (0.3–1.6)	0.6 (0.2–1.9)	0.4 (0.1–3.2)
Weaker social bonds[b]	377	7.7	2.3 (1.1–5.0)	1.0 (0.3–2.9)	1.8 (0.5–6.4)
Poorer help[b]	377	14.1	0.8 (0.4–1.5)	2.0 (1.0–4.2)	0.5 (0.1–2.4)
General health status					
Less than excellent self-rated health	377	83.0	0.5 (0.3–0.8)	1.2 (0.5–2.6)	5.0 (0.7–37.7)
Current or ex-smoker	377	53.6	1.7 (1.1–2.6)	5.1 (2.4–10.9)	2.8 (1.1–7.1)
>12 physician's visits in the last year	376	6.4	0.7 (0.3–1.7)	0.9 (0.2–3.0)	0.6 (0.1–4.8)
>5 drugs	377	4.8	0.4 (0.1–1.4)	3.3 (1.2–9.3)	1.9 (0.4–8.9)
>3 chronic diseases	363	5.2	0.7 (0.2–2.0)	1.8 (0.6–5.6)	4.6 (1.4–15.1)
Disability in ≥1 BADL	377	4.8	0.4 (0.1–1.4)	0.3 (0.1–2.7)	6.8 (2.2–21.3)
Cognition and mood					
MMSE ≤21	377	9.8	1.0 (0.5–2.0)	1.0 (0.4–2.6)	1.9 (0.6–6.0)
GDS ≥14	375	21.6	0.7 (0.4–1.2)	1.1 (0.5–2.2)	1.9 (0.8–4.6)
HSCL >1.5	374	7.5	0.3 (0.1–0.9)	1.8 (0.7–4.6)	1.1 (0.3–5.1)

[a]Prevalence of the factor indicated in column 1 out of the total number of valid observations indicated in column 2.
[b]10th percentile of the whole population distribution.
Abbreviations: OR: odds ratio. CI: confidence intervals. Other abbreviations as in Table 1.

Table 3
Logistic regression analysis of alcohol-related problems: parsimonious models after backward deletion of the redundant variables

	>40/20 g/day		CAGE 1+		MCV-γGT +	
	OR (95%CI)	P	OR (95%CI)	P	OR (95%CI)	P
Alcohol intake (per 10 g/day)	not tested		1.2 (1.1–1.3)	0.001	1.2 (1.1–1.4)	0.003
Age (75+ vs. 64–75 years)	0.6 (0.4–1.0)	0.053	2.4 (1.2–5.0)	0.018	—	—
Sex (female vs. male)	—	—	—	—	0.3 (0.1–1.0)	0.050
Being unmarried (yes vs. no)	—	—	0.2 (0.1–0.7)	0.008	—	—
Weaker social bonds (yes vs. no)	2.7 (1.2–5.9)	0.016	—	—	—	—
Poor help from contacts (yes vs. no)	—	—	3.5 (1.3–9.1)	0.012	—	—
Less than excellent self-rated health (yes vs. no)	0.5 (0.3–0.9)	0.020	—	—	5.3 (0.7–41.7)	0.111
Smoking (yes vs. no)	1.9 (1.2–3.0)	0.009	4.2 (1.7–10.1)	0.002	—	—
>5 drugs (yes vs. no)	—	—	—	—	—	—
>3 chronic diseases (yes vs. no)	—	—	—	—	—	—
BADL disability (yes vs. no)	—	—	—	—	12.2 (3.2–45.7)	0.000
Anxiety (HSCL score >1.5 vs. ⩽1.5)	0.3 (0.1–1.0)	0.053	—	—	—	—

All the variables listed were included in each of the three initial models, except daily alcohol intake, which was not entered in the first model (>40/20 g/day). A dash indicates that the variable has been backward deleted from that model.

[a]Due to some missing data, 18 of 377 cases (4.8%) were not included in the analysis. See Tables 1 and 2 for abbreviations.

4. Discussion

Depending on the definition considered, the prevalence of at-risk drinkers in Dicomano ranged from 8.9% to 19.1%, higher than in previous studies [2,25]. This result is a further confirmation [26] of the "single population theory" [27], postulating that average alcohol consumption and prevalence of heavy drinkers are closely related. Indeed, among Italian regions, Tuscany ranks third for wine consumption and Dicomano lies within a wine-producing area, in which the highest Italian mean alcohol intake has been recorded [6,16]. Accordingly, 93.2% of alcohol intake in our study population came from wine, which is part of everyday meals even at an advanced age. Although the proportion of at-risk drinkers was substantially lower among older individuals, markers of possible alcohol problems were not less common in participants older than 75 years, in agreement with the hypothesis that an advanced age increases, per se, the risk for alcohol problems [28,29]. Specifically, for any given alcohol intake, older individuals appeared to exhibit some psychosocial distress, as suggested by a positive CAGE questionnaire, whereas positive biological markers were more frequent in men with a compromised health status.

In studies of older primary care persons, with a cut-off of 2 the CAGE questionnaire proved to be 63–70% sensitive and 82–93% specific for a diagnosis of alcohol abuse and dependence [30]. Thus, this instrument adequately detects the most severe behavioral disorders related to alcohol consumption. However, the CAGE questionnaire has a relatively poor performance, especially when compared to the Alcohol Use Disorders Identification Test (AUDIT), in recognizing milder drinking disorders [30]. Even with a cut-off of one [21], the sensitivity of the CAGE questionnaire is in fact low in middle-aged persons [30] and in older community dwellers [11,25,26]. In a large sample of older primary care patients Adams et al. [11] reported that this instrument detected 31%, 63%, and 59% of those who were at-risk drinkers (more than 14 drinks/week for men and 7 drinks/week in women), heavy drinkers (more than 21 drinks/week), or binge drinkers, respectively. Accordingly, the authors concluded that the CAGE questionnaire is "insufficient to detect the full spectrum of problem drinking seen in a primary care population" [11]. A strategy that associates the CAGE questionnaire and questions on quantity and frequency of drinking has been suggested as pragmatic and promising [11,30]. However, self-reported intake can be inaccurate [31] and, as Fink et al. [29] pointed out, ideal screening instruments should aim at identifying older persons with alcohol problems regardless of their intake. Our findings seem to support this point of view. Indeed, no clear evidence of harm was reported by participants who drank above recommended limits, whereas positive markers of alcohol problems were associated with some features of physical or psychological discomfort (Table 2). These associations were independent of the actual alcohol intake, as confirmed in multivariate logistic regression analyses (Table 3).

As the results of the present study suggest, no single screening instrument, even when used in association with self-reported data on alcohol intake, appears to entirely cover the wide spectrum of alcohol problems in older persons. Yet, the association of behavioral interviewing and metabolic evaluation might improve the ability to identify older persons with alcohol problems in the community. Indeed, we observed that the CAGE questionnaire and the MCV-γGT test were poorly related to each other and identified individuals who differed for several characteristics. CAGE-positive subjects were older and complained of inadequate social support, whereas MCV-γGT-positive subjects were predominantly male, sicker and disabled individuals. This is not surprising, when the different constructs of the two instruments are taken into consideration. However, the consequences of this difference for the clinician had not been described so far.

Major strengths of this study are its population-based design, particularly focusing on a community with a diffuse so-

cial acceptance of drinking behavior, the large proportion of participants older than 75 years, and the multidimensional approach, which allowed us to examine different aspects—clinical, physical, functional, and psychosocial features—potentially related to alcohol problems. Several limitations of this study should be also acknowledged. We examined a rural community with a poor level of formal education. Whereas other rural populations exhibited similar drinking characteristics [32], our results might be less generalizable to other settings. The self-reported frequency–quantity questionnaire did not allow assessment of binge drinking. However, in the traditional Italian culture binge drinking is uncommon, as compared to other non-Mediterranean cultures. Indeed, in the study population more than 90% of total alcohol intake came from wine, and drinking wine is a part of everyday activities such as eating. An accepted standard for alcohol abuse was not available in the study, and we could not assess the lifetime prevalence of alcohol problems and the reasons for not drinking in those who denied alcohol use. Finally, the combined increase in MCV and γGT, which yielded results similar to those originally reported in younger male workers [12], could be attributed also to reasons unrelated to excessive alcohol consumption. This might explain its association with comorbidity and disability and diminish its value as a true marker for alcohol problems. Nevertheless, if ever a positive MCV-γGT test is related to a poor health status more than to alcohol intake itself, drinking should be considered as inappropriate in this condition as well.

In conclusion, it should be emphasized that, based on frequency–quantity information on alcohol consumption, at-risk drinking can be very common in the elderly. Paradoxically, when specific markers for alcohol problems are absent, psychophysical well being is the dominant hallmark of at-risk drinking, as demonstrated by this and by other studies [25,33]. Therefore, when physicians' inquiry on alcohol use is restricted to intake information and does not assess the consequences of use, it cannot distinguish between safe drinking, at-risk drinking, and alcohol problems [9]. On the other hand, evidence for alcohol problems is independently and distinctively provided by psychosocial and biological investigations. Their combination could overcome some of the limitations of either screening approach used individually.

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